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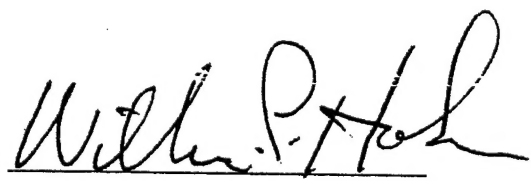
Surge Shipping and the U.S. Expeditionary Strategy:
10 Pounds in a Five Pound Bag?

By

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A paper submitted to the faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Abstract of

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The military strategy of the armed forces is an expeditionary one, and growing more so. While the surface Navy is increasingly focused on direct littoral operations, deep strike, and supporting fires for Army and Marine Corps land forces, its biggest challenge may be in the open ocean. Surge sealift is the most critical factor enabling the U.S. expeditionary strategy, and at the same time is extremely vulnerable.

Large portions of the assault force and its immediate support are either positioned on ships overseas or must arrive promptly by sealift from the United States. Much of this shipping is unique or irreplaceable. Historically, anti shipping wars have been contests of attrition and staggering losses are caused by even modest enemy forces. With so much U.S. military capability in such a limited amount of surge shipping, each unit becomes immensely important to protect, requiring an enormous amount of resources against a determined adversary. The U.S. Navy may find that protection of this shipping diverts a large number of assets away from a littoral role. It is time to reexamine the dependence on surge shipping and the requirements for its protection.

Surge Shipping and the U.S. Expeditionary Strategy

The military strategy of the armed forces is an expeditionary one, and growing more so. The U.S. Army is evolving to lighter, more strategically mobile forces. The Air Force has created routinely deployable Aerospace Expeditionary Forces. Meanwhile, the Navy-Marine Corps team has always been an expeditionary force, continually deployed overseas, and maintaining a forcible entry capability.

While the surface Navy is increasingly focused on direct littoral operations, deep strike, and supporting fires for Army and Marine Corps land forces, its biggest challenge may be in the open ocean. *Surge sealift* is the most critical factor enabling the U.S. expeditionary strategy, it is vulnerable, and it will require an enormous amount of resources against a determined adversary. Its protection is a role that can only be performed by the surface Navy. These issues will be discussed below in more detail.

Sealift will be important for long term sustainment of any expeditionary warfare effort because the amount of supplies available via shipping is simply implausible to match via airlift. However, the focus of this paper will be on sealift needed in the near term during a military operation, or *surge sealift*. This is shipping that is needed for the immediate assault and its support, generally within the first 30 days. As defined for this paper, it includes ships of the Afloat Prepositioning Force (APF), tanker support, and the Fast Sealift Ships (FSS) deploying from the continental United States, as well as Navy amphibious assault ships.¹

As a power projection force, the U.S. military deploys from the continental U.S. and from select locations around the world. *Power projection* depends on rapid deployment of sufficient military power to overwhelm with *decisive force* which "... in

the early stages of a crisis can be critical to deterring aggression.”² Early introduction of forces into a theater is fundamental premise of U.S. military strategy. Peacetime and wartime scenarios for the US military strategy depend entirely on lift, or *strategic agility*. Light forces and personnel go to the fight by air, but 95% of equipment is moved by sea to the theater, including all heavy forces. Units fly to the theater and “fall in” on their equipment arriving nearly simultaneously by sea, helping create a synergy “that applies force from different dimensions to shock, disrupt, and defeat opponents.”³ Support shipping has become the most vital element in the U.S. expeditionary warfare strategy. It is a “Go-No Go” issue. If the shipping is not there to provide heavy forces, combat support, and supplies, then any military operation will not happen.

Amount, Timing, and Type of Surge Shipping are all Vital

Surge sealift has acquired additional, critical importance over sustainment shipping because of the amount and type of equipment it brings, and the timing required for its arrival.⁴ The amount itself is staggering. By 2002, half the equipment for the Army’s 10 divisions will be prepositioned in ships overseas.⁵ About half of Marine Corps equipment is also prepositioned, and obviously almost its entire strength arrives in theater by ship. Obviously all fuel used by operating forces must come by ship.

The type of equipment within the prepositioned forces is also critical, and not simply the hardware carried by the ships for use by the fighting forces. Indispensable parts of prepositioned forces are certain specialized ships and logistics equipment. There is little redundancy in these unique items, they are not easily replaceable, and they are not air transportable. Crane ships, lighterage, portable piers, barges, and tugs to offload and transport supplies in stream, and ship-based systems for transferring bulk liquids and

fuels ashore, are included. However, because Desert Shield and Desert Storm provide the most publicized recent history for surge and sustainment shipping, the critical nature of this logistics equipment may not be appreciated. Iraqi forces did not systematically attack sealift or the Saudi port of Jubayl, and the Allies could offload virtually unlimited amounts of supplies with impunity in one of the most modern port facilities in the world. Plentiful host nation fuel support minimized the need for tankers and ship-to-shore liquid offload capability. Even with these benign conditions, the port operating equipment (e.g. tugboats, floating cranes, utility landing craft, forklifts, containers, and support parts) brought by the APF was "indispensable during the operation's first days."⁶ In any event, the port conditions extant in Saudi Arabia can not be considered routine. In terms of draft sufficiency alone, less than 40% of the worldwide ports considered by U.S. strategic logistics planners meet requirements.⁷

Surge shipping vulnerabilities.

It is clear that surge shipping is critical to success in a forcible entry context. It brings the heavy vehicles, the fuel, the equipment to offload follow-on cargo shipping, and supplies for the period after the first 2 weeks. However, as important as it is, it has some significant vulnerabilities regarding organic protection capabilities, the construction of the ships, and their immense value.

The most obvious vulnerability is their lack of robust organic protection. Naval amphibious shipping has minimum self defense protection against air attack, virtually none against subsurface attack, and recent plans to construct the LPD 17 class with a full combat capability were dropped. The vast majority of amphibious ships do not have modern combat data link capability. However, Naval amphibious shipping operates

regularly with other Navy combat units, and have standing procedures for limited group self protection using Marine Corps assets on board, such as combat helicopters, or some fixed-wing protection in the case of "big deck" ships. Realistically though, protection from any reasonably advanced military threat will have to be provided by combatants.

The APF, tankers, and FSS are entirely unarmed and depend on combatants for all of their protection. Developments in containerized weapons systems may offer promise for the future. Significant combat capability can be built into units the size of standard shipping containers. Additionally, modular weapons stations may offer some options to consider.⁸ Otherwise, these ships will continue to need protection assigned to them. This includes in their ports. During peacetime in port, the only personnel aboard are the skeleton maintenance crews. These ships, especially those prepositioned overseas, would make an attractive target for a surprise terrorist attack, with a relatively small loss of life but strategically significant impact.

A vulnerability of the APF and FSS is their construction. They do not possess the extensive compartmentation common to Navy ships, so they are more susceptible to sinking by hull damage. This is exacerbated by the large, open design of the cargo areas, which would cause serious stability problems in any internal flooding situation. Modern fire extinguishing systems are installed, however, because of the immense amount of vehicles onboard and attendant fuel.⁹ Naval amphibious shipping is of course built to naval combatant standards regarding compartmentation, and is manned by sailors who train for damage control regularly.

The last and most important vulnerability of this shipping is the value arising from their small numbers, immense amount of equipment onboard, and indispensability

in the initial assault and follow-on. This is especially true with the ships of the Afloat Prepositioning Forces, and the Fast Sealift Ships. They are not simply lucrative targets; they are a natural operational center of gravity. For example, of the 8 FSS during Desert Storm,

“...the typical FSS load included more than 700 Army vehicles such as M-1 tanks, M-2 fighting vehicles, and fuel trucks. By comparison, 116 World War II Liberty ships would have been required to move the same tonnage in the same period.”¹⁰

This enormous capability packed into the relatively small numbers of ships in the APF and FSS means that the fewer there are, the more each of them matters. The delay of even one has significant effects.¹¹ A single FSS that broke down off the U.S. East Coast during Desert Storm delayed unit completion of the 24th Mechanized Infantry Division by three weeks since 15% of the unit equipment was onboard. Without it, the division was grounded. Fortunately, the equipment could be sent on later once the ship was towed to Spain.¹² For ships with specialized functions in the APF, their loss would have a potentially greater impact.

Not only is roughly half the U.S. heavy land combat capability in prepositioned ships, but the monetary impact of each ship is also tremendous, with the newer ones each containing probably a billion dollars or more worth of equipment onboard, roughly the cost of an AEGIS cruiser.

Tankers also present a serious numbers problem. The U.S. military will require 90 of the entire world's projected fleet of about 110 militarily useful tankers to fully execute the national military strategy.¹³ Less than half of those available are projected to

be under U.S. flag so they will either be acquired, or chartered as needed. Each and every tanker will be extremely valuable to the U.S. effort. The subject of future tanker availability would be worthy of an entire study unto itself and will not be addressed further herein.

Shipping Wars are Attrition Wars

The most significant impact of having only a small number of assets is in a war of attrition, such as shipping wars. These have generally been wars of strategic interdiction, against a country's merchant fleet. The adversary tries to destroy more shipping than can be replaced, thereby destroying an enemy's means of national production, and his war-making ability. With the notable exception of the U.S. submarine war against Japanese merchant shipping in WWII, these efforts have generally proved indecisive, because they devolve into contests of industrial production, and the war ends meanwhile for some other reason.

The numbers of ships sunk in major anti-merchant shipping operations are staggering, even just considering submarines as the adversary. With an average of less than 11 U-boats at sea in 1940, the Germans sank 471 Allied ships.¹⁴ From January to July 1942, a dozen U-boats deployed to U.S. waters sank 198 ships.¹⁵ Six U-boats deployed to the Black Sea from 1942-44 kept the Russian fleet effectively bottled up.¹⁶ Generally, a quarter of the operational U-boat fleet was at sea, with the remainder in the yards, training, or in sea trials. Overall, the return on investment for a submarine attacking independent shipping during WWII was nearly 13:1, and submarines sank 25% of independent shipping. Against shipping protected by convoy, the exchange ratio was 0.5:1, with less than 1% sunk.

Protection of shipping to resupply NATO during a war in Europe was modeled extensively during the Cold War. Various force levels, multiple barriers provided by surface, air, and subsurface assets, and differing probabilities of detection and kill were all tried in numerous mathematical models. The most optimistic planning models estimated an exchange ratio of roughly 3 ships for every Soviet submarine, and a loss of roughly 1/3 of U.S. military equipment enroute to Europe "even if the Soviets dedicated a relatively small number of their submarines" to anti-shipping activities.¹⁷

Past experiences of anti-shipping campaigns are not exact parallels to the issue of protecting modern surge shipping, because earlier efforts against merchants were indiscriminate. Any merchant of the enemy country was fair game. Target identification was not an issue. However, preventing a U.S. landing by destroying the ships involved, means identifying them. In the case of ships departing from U.S. ports this would be complicated considering the great amount of normal traffic. However, it would not be difficult around locations of the Afloat Prepositioning Forces. Presumably, identification would not be an issue in the area of operations, either. There are other differences to consider between past anti-shipping campaigns and the protection of modern surge shipping, including vessel speeds, weapon capabilities, detectability. However, none of these differences offer such an advantage to one side or the other that lessons from past experiences can be disregarded.

Some Historical Lessons

Some important insights regarding protection of surge shipping can be implied from examining historical anti-shipping operations. One is that even a modestly sized adversary force can cause a lot of damage before it is neutralized. Another is that

independent transits fare much worse—25 times as badly-- than closely escorted shipping. Further, despite determined resistance and protection, losses continue to occur. They do not fall to zero. An anti-shipping operation is an attrition campaign, and so is defense against it. Sea control is much less permanent than is air control, and subsurface control is generally even more in doubt, more localized, especially if the attacker has the advantage of surprise.

Independent transits, patrolling, and convoy are all methods that have been studied and tried in attempts to beat an anti-shipping threat. The data overwhelmingly support convoy. Independent transits have been unsuccessful because they did nothing to reduce the enemy threat, leaving the shipping vulnerable. Patrolling for submarines also has not been an effective process "...which, even when most thoroughly planned, still resembles looking for a needle in a haystack," according to Mahan.¹⁸

An intense program of patrolling and barriers in Otranto during 1918 at the entrance to the Adriatic attempted to demonstrate the effectiveness of a large-scale hunting offensive against U-boats. More than 27 destroyers, 15 submarines, and 36 subchasers were arrayed against an average of 10 submarines over a 44-mile front. In all, over 280 vessels were involved. The effort was unsuccessful.¹⁹ Later, in WWII, Navy Commander in Chief Ernest J. King would remark in a letter to General Marshall, Army Chief of Staff, "the so-called patrol and hunting operations have time and again proved futile... escort is not just one way of handling the submarine menace; it is the only way that gives any promise of success."²⁰

Escort or convoy works because it forces contact. The submarines go where the shipping is. Escort also works because it concentrates all the mass of the escorts to bear

on the submarines.²¹ Finally, it works because the number of submarines available to attack shipping is gradually reduced. Thus far, there have been no “quick decisive victories” in shipping wars.

How Should Shipping Losses in Transit be Minimized?

Insights from past shipping wars indicate that subsurface threats to shipping are historically the most dangerous, effective and demanding, so the protection required to counter that capability is examined below.

The number of escorts required to provide adequate protection for surge shipping will be sharply increased over historical levels, considered on a per-ship basis. The number of escorts required is determined by the geographic footprint of the convoy and the area to be searched, not the number of ships being escorted. For surge shipping, due to their vastly increased size, they require quite a bit more maneuvering room in an escort environment than merchants or transports did in the past. For example, the Fast Sealift Ships and the newer ships of the Afloat Prepositioning Force are enormous at over 900 feet long, nearly the size of an aircraft carrier. This larger convoy footprint implies that a given number of ships would require more escorts than would have been assigned in the past.

Another factor that increases the area to be searched for modern shipping is the likely attack range for torpedo threat. The average range for torpedo attack in WWII was roughly 500 yards, whereas it would probably be at least 5-10 times farther now, thereby increasing the area to be searched.²²

The increased area to be searched alone would require more escorts than in WWII to provide the same level of protection. To get more protection, or to reduce the

likelihood of successful submarine attack, means sharply increasing the number of escorts assigned. Past experience and data showed that doubling the number of escorts reduces casualties by more than half, and at the same time more than doubles the number of subs successfully attacked per ship sunk.²³ This works for two reasons. First, there is a greater concentration of force to counter each submarine attack, so their force is reduced faster. Second, more escorts mean more search barriers to pass through on the way in for an attack. Anti-shipping models used for NATO war in Europe also support this mathematically.

Another way to increase the destruction of enemy submarines, demonstrated by past experience, is to assign distant support groups to augment direct escort increased. If an attack against shipping takes place, the distant support group continues the counterattack as a dedicated force while direct protection remains with the shipping. It also serves as an intelligence-cued interdiction force. Considering the value of surge shipping, it the Navy might consider that option.

How Many Escorts are Required?

In a time-constrained operation involving a small number of high value units critical to both sides, protecting against a determined adversary equipped with even a modest force will require a lot of resource effort. It is not the purpose of this paper to specify exact numbers of escorts, what kinds are most suitable, or how to use them. However, a working estimate of 1.5-2 escorts per ship escorted would not be excessive.²⁴ For two separate groups of afloat prepositioning ships coming from Guam (5) and Diego Garcia (4), and 8 Fast Sealift Ships entering the theater, over 20 escorts would be required to provide protection that reduces risk to these ships. Add escort protection

required for Amphibious assault shipping, the carrier and the battlegroup organic logistic ship, and this quickly becomes a resource intensive problem, especially in light of Navy reductions in open ocean search aircraft.²⁵

There is a possibility that this mission, rather than land strike operations, will drive initial naval force requirements in a contingency. Aside from the numbers alone, the geographic dispersal of escorts that might be required would negate the ability of multimission platforms to contribute synergistically to the land battle. In WWII, roughly 275 British Navy ships were 100% occupied with direct escort duties, and 85% of the surface Navy was involved with full time antisubmarine operations.²⁶

Protection of Shipping Will Fall to Navy

During WWII, protection of shipping was a joint effort for the United States armed forces. Army air forces flew a considerable number of missions in support of merchant convoys. Today, however, the only service with a mission of area control on the open ocean is the Navy, so resources to be assigned to all shipping will most likely be Navy.

Current doctrine regarding protection of surge shipping in transit is not explicit. Joint Pub 4-01.2 chapter VII, regarding Naval Control of Shipping, provides the most guidance. However its clear purpose is to deal with commercial shipping under general threat in wartime. The Maritime Prepositioning Squadrons, the Afloat Prepositioning Ships, and the Fast Sealift Ships, each fall into slightly different categories regarding assignment of transit protection. Geographic Combatant Commanders, the Supported and Supporting Commander in Chief will need to coordinate closely to ensure adequate protection is assigned during transit of these ships to the theater.

The Time Phased Force Deployment plan shows what military forces flow in to a theater and on what schedule. Having numbers of escorts tentatively assigned to surge shipping in various threat risk environments might provide better visibility for the need to protect these assets.

Other Options

One option is to simply build more surge shipping, thus decreasing the extreme dependence on a few ships. It has been shown above that the probability of any one ship getting destroyed is lessened if there are more ships, and at the same time, more smaller ships can maneuver safely in the same size protected area than fewer larger ships. Fewer escorts are required for protection of a smaller area. It also helps the concept of "spread loading" in which a particular commodity, say tanks, are distributed among several ships instead of stored on one, in order to reduce the chance of losing all of them if a ship is sunk. With only a few ships, there is little real spread loading.

Reducing the number of ships sitting in a vulnerable state at overseas locations could also be considered. Putting more of the equipment ashore would help. Pulling the Afloat Prepositioning Ships back to the continental U.S. could be considered.

Another option to increase the survivability of surge shipping includes further development of portable containerized weapons systems. Gun systems, surface-to-air missile systems, anti-torpedo defense systems can all be developed to fit inside standard sized shipping containers.²⁷ Modular systems are in development already for a wide variety of applications. They could easily be adapted to be placed onboard surge shipping, or even sustainment shipping if necessary, thus decreasing the amount of naval escorts required, or at least increasing their defensive capabilities. Manning for these

systems would of course have to be considered. This would be a natural role for naval reserve personnel who could be assigned to a specific type of modular or containerized system, and who could train with it ashore locally.

There is a more general aspect to containerization that may help reduce vulnerability. That is an increased emphasis on standard shipping container sizing for supplies and even military hardware such as vehicles and weapons systems. A standard container has a capacity of roughly 29 metric tons. Special pallets and other container modules that fit in multiples of standard shipping containers can be used as sizing guides.²⁸ The advantage is that by using regular commercial shipping for most needs, the identification problem for an adversary becomes virtually insurmountable. Charter shipping can be used for most needs. Modular vehicle systems could be developed and containerized. The amount of specialized handling equipment required could be minimized to what is needed to for offloading in various environments. The less unique ships there are, the easier it will be to protect them, and the easier they will be to replace. Current sealift capabilities require a large amount of specialized handling equipment, and even the ships themselves are of configurations unique to the military. Roll-on/Roll-off shipping, for example, is not commercially viable. Maximizing the use of commercial intermodal equipment should be the norm. An advantage of pressing for smaller, lighter, or more modular military hardware is that more of it will become air-transportable, thus increasing flexibility for delivery methods.

Another option for reducing vulnerability is to simply build surge shipping to military standards, and operate them with military crews. They are, after all, an integral

part of the expeditionary strategy. The personnel costs involved in this option make it unlikely.

Operating with surge shipping or exercising with them as part of normal deployment and battle group operations would bring planning for them into the fore. Currently it is unusual for a battle group to actually operate with and practice for escorting them. Amphibious Ready Group deployment schedules do not directly correspond with Carrier Battle Group deployments, and it is still rare to conduct extensive, close escort of amphibious assault shipping in exercises, where much protection is simply simulated. Making the protection of surge shipping and attacks on them a serious part of wargaming efforts would also help publicize the issue at the operational and tactical levels. Certainly there is a need to readdress models and studies of this subject in light of its importance to the national military strategy.

Conclusion

Surge shipping is an immensely important lynchpin in U.S. expeditionary strategy. As long as power projection, decisive force, and strategic agility remain critical elements in national military planning, surge shipping will occupy a vital place. Supply shipping has always been important, but the nature of modern surge shipping has elevated this importance to an operational center of gravity for the U.S. military strategy. Due to its small numbers, specialized capabilities, and immediate need, it has an intense value to both the U.S. and any potential adversary. To the U.S. Navy will fall the lion's share of its protection. Though the Navy is increasingly looking landward with its focus on direct support of operations ashore, including deep strike and naval fires, protecting surge shipping in transit may require the diversion of an unexpectedly large amount of Naval

forces from a littoral role. Anti-shipping wars are attrition campaigns and minimizing losses of critical surge shipping assets may require many more resources per ship or group of ships protected than has been the experience in the past. It is appropriate to take a new look at both the importance and the vulnerability of surge shipping.

NOTES

¹ The Afloat Prepositioning Force (APF) has two elements, the Maritime Prepositioning Squadron (MPS) of the US Marine Corps, and the Afloat Prepositioned Ships (APS) for the Army and Air Force. The 13 ships of the MPS consist of 3 squadrons located in Diego Garcia, Guam, and South Carolina, each with equipment for a heavy brigade and 30 days of supply. The planned APS is 14 ships berthed in Diego Garcia, Guam, Saipan, and the Mediterranean, organized and equipped similarly. The Defense Logistics Agency also maintains ships in these locations with equipment onboard. There are 2 crane ships for unloading other ships in unimproved ports, 2 designed to pump fuel from up to four miles offshore, 1 heavy lift ship with tugs and barges aboard to offload and move supplies ashore, and tankers. In all, the vast majority of U.S. capability to materially sustain its land forces ashore in hostile or unimproved areas is located in prepositioned assets. See Joint Pub 4-01.6, "JTTP for Joint Logistics Over-the-Shore."

² Chairman of the Joint Chiefs of Staff, National Military Strategy of the United States of America, Washington, D.C.: 1997, p.19.

³ U.S. Joint Chiefs of Staff, Joint Tactics, Techniques, and Procedures for Sealift Support to Joint Operations (Joint Pub 4-01.2) Washington, D.C.: 1996, p.xi.

⁴ The landing force is divided into the assault echelons (AE) and assault follow on echelons (AFOE). Both should be embarked in amphibious shipping, but due to lack of assets, the AFOE is embarked in sealift shipping. It is normally needed within 5 days. During amphibious assaults of the past, all troops and equipment came ashore together, disembarked from Navy assault shipping. This is no longer the case. Civilian shipping is now part of the team, and carries the AFOE. Though ostensibly to be used in a benign environment, and following the AE, it is difficult to imagine it being held away if complete area superiority has not been achieved; the AE only have supplies for 15 days maximum. See U.S. Joint Chiefs of Staff, Joint Tactics, Techniques, and Procedures for Sealift Support to Joint Operations (Joint Pub 4-01.2) Washington, D.C.: 1996, p.VI-12.

⁵ Mahnken, Thomas G., "Deny U.S. Access?" *Proceedings*, U.S. Naval Institute, September, 1998, p.36-39.

⁶ DoD Final Report to Congress, Conduct of the Persian Gulf War, April 1992, quoted in Joint Pub 4-01.2, p.IV-12.

⁷ Military Traffic Management Command Transportation Engineering Agency, Logistics Handbook for Strategic Mobility Planning, Newport News, VA: 1997, pp. D-5-D30.

⁸ Lok, Joris Janssen, "Denmark Takes Stanflex System Further," *Jane's International Defense Review*, Volume 33, March 2000, p.22.

⁹ During the Falklands campaign, a single Exocet cruise missile sunk the British merchant ship *Atlantic Conveyor*, being used as amphibious supply shipping. Fires

combined with explosions caused by unburned rocket motor fuel in the missile were the causes.

¹⁰ DoD Final Report to Congress, Conduct of the Persian Gulf War, April 1992, quoted in Joint Pub 4-01.2, p.II-6.

¹¹ If a force is too small, the loss of even a few units can jeopardize the entire effort. Captain Wayne P. Hughes, USN (ret.) reportedly refers to this as "tactical instability."

¹² Joint Pub 4-01.2, p.II-6.

¹³ A militarily useful tanker is about 70,000 tons, small by commercial standards, and getting smaller in construction trends of the world's tanker market. World shipping regulations require that all tankers be of double-hull construction according to a phased schedule. The number of tankers available by 2003 is projected to be 107. About 45 of these will probably be U.S. flagged. Information is from Maritime Administration Office of Statistical and Economic Analysis, and from the White Paper briefing regarding Tanker Requirements in Preparation for the Next Mobility Requirements Study, presented to the Military Sealift Committee Meeting at the National Defense Transportation Association, 29 October 1997.

¹⁴ Nitze, Paul H, Leonard Sullivan, Jr., and the Atlantic Council Working Group on Securing the Seas, Securing the Seas: The Soviet Naval Challenge and Western Alliance Options, Boulder, CO: Westview Press, 1979, p.340.

¹⁵ Bowling, p.409.

¹⁶ Vego, Milan N, Naval Strategy and Operations in Narrow Seas. Portland, OR: Frank Cass, 1999, p.231.

¹⁷ Nitze, p.372.

¹⁸ Bowling, p.29.

¹⁹ *ibid.*, p.246.

²⁰ *ibid.*, p.648.

²¹ Lanchester showed that for aimed fire, quantity matters more than quality. Firepower effectiveness is proportional to the square of the number of weapons engaged... not in simple direct proportion to weapon effectiveness, like quality. Convoy experience overwhelmingly supports this. Hughes, Wayne P. Jr, Fleet Tactics: Theory and Practice, Annapolis, MD: Naval Institute, 1986, p.67. For a more general discussion see Operations Evaluation Group, A Lanchester-Type Model for Combat Between Submarines, Carrier Task Groups, and Hunter-Killer Groups, Washington, D.C.: 1962.

²² Specifically, the number of perimeter escorts for a convoy varies as the radius while the number of ships in the main body varies as the radius squared. Bowling, p.626, and doubling the range of search requires quadrupling the area of coverage around a point. Hughes, p.167.

²³ The more escorts there are, the higher the probability of detecting a submarine, because the submarine is subjected to more "looks." Bowling, p.672. See also Operations Evaluation Group, Model of Anti-Convoy Effectiveness (MACE): A Computer Model for Anti-Shipping Wars. Washington, D.C.: 1969.

²⁴ Consider a multiple column formation of ships with 1000 yard spacing, and active sonar search sectors of 4000 yards such that the sectors extend 4000 yards from the formation body in every direction. The number of escorts required is the length of the entire perimeter divided by 4000 for 360-degree protection, or .75 of that result for protection on the front and sides.

²⁵ Holzer, Robert, "U.S. Navy Targets Shortfall in Antisub Aircraft," *Defense News*, Vol 15, No. 17, May 1, 2000, p.3.

²⁶ Bowling, p.622.

²⁷ Lok, Joris Janssen, "Denmark Takes Stanflex System Further," *Jane's International Defense Review*, Volume 33, March 2000, p. 22.

²⁸ Logistics Handbook, p. 80.

BIBLIOGRAPHY

Allied Tactical Publication 2, Volume 1. n.p.: n.p. n.d.

Barnett, Roger W. Center for Naval Warfare Studies, Naval War College. Surface Ship Survivability : Risk Management and Network Centric Warfare. Newport, R.I.: 1998.

Bowling, Roland Alfred. The Negative Influence of Mahan on the Protection of Shipping in Wartime: The Convoy Controversy in the Twentieth Century. Ann Arbor, MI: University Microfilms International. 1982.

Brosnan, John F. "An Amphibious Landing? With Civilian Ships?" Naval War College Review, March-April 1986, 35-42.

Center for Naval Analyses. Operations and Support Division. Sealift in Operation Desert Shield/Desert Storm: 7 August 1990 to 17 February 1991. Alexandria, VA: 1991.

_____. Roles, Strategy and Forces Division. The U.S. Experience in Forcible Entry, Sustained Land Operations, and Sustained Land Combat Since World War II. Alexandria, VA: 1995.

_____. Center for Naval Analyses. Strategy and Forces Division. Operation Restore Hope: Summary Report. Alexandria, VA: 1994.

Chairman of the Joint Chiefs of Staff. National Military Strategy of the United States of America. Washington, D.C.: 1997.

Department of the Navy Naval Doctrine Command. Naval Control and Protection of Shipping (NWP 3-07.12). Norfolk, VA: 1996.

Foxwell, David, and Joris Janssen Lok. "Enter a New Breed of Amphibians," *Jane's International Defense Review*. Vol 33, March 2000.

Gatchel, Theodore L. At the Water's Edge: Defending Against the Modern Amphibious Assault. Annapolis, MD: Naval Institute, 1996.

Hewish, Mark, and Joris Janssen Lok, "Return of the Big Guns at Sea," *Jane's International Defense Review*. Vol 33, April 2000.

Hughes, Wayne P. Jr. Fleet Tactics: Theory and Practice. Annapolis, MD: Naval Institute, 1986.

Landersman, S.D. "Naval Protection of Shipping: A Lost Art?" Naval War College Review, March-April 1986, 23-34.

Lok, Joris Janssen. "Denmark Takes Stanflex System Further," *Jane's International*

Defense Review. Volume 33, March 2000.

Menarchik, Douglas. Powerlift—Getting to Desert Storm: Strategic Transportation and Strategy in the New World Order. Westport, CT: Praeger. 1993.

Mulholland, David. "U.S. Air Force, Army Team to Hunt Mobile Launchers." *Defense News*. Vol 15, No. 17. May 1, 2000.

Military Traffic Management Command Transportation Engineering Agency. Logistics Handbook for Strategic Mobility Planning. Newport News, VA: 1997.

Naylor, Sean D. "Airlift not Sufficient for Army Strategy," *Army Times*, May 3, 2000.

Nitze, Paul H, Leonard Sullivan, Jr., and the Atlantic Council Working Group on Securing the Seas. Securing the Seas: The Soviet Naval Challenge and Western Alliance Options. Boulder, CO: Westview Press, 1979.

Office of Naval Intelligence. Violence at Sea—Piracy 1993-1994. Washington, D.C.: 1995.

Operations Evaluation Group. A Lanchester-Type Model for Combat Between Submarines, Carrier Task Groups, and Hunter-Killer Groups. Washington, D.C.: 1962.

_____. Model of Anti-Convoy Effectiveness (MACE): A Computer Model for Anti-Shipping Wars. Washington, D.C.: 1969.

U.S. Joint Chiefs of Staff. Joint Tactics, Techniques, and Procedures for Sealift Support to Joint Operations (Joint Pub 4-01.2) Washington, D.C.: October 9, 1996.

Vego, Milan N. Naval Strategy and Operations in Narrow Seas. Portland, OR: Frank Cass, 1999.

Williams, E. Cameron. "The Four 'Iron Laws' of Naval Protection of Merchant Shipping" Naval War College Review, May-June 1986, 35-43.

Winton, John. Convoy: The Defence of Sea Trade 1890-1990. London, England: Michael Joseph Ltd, 1983.

Ya'ari, Yedidia. "The Littoral Arena: A Word of Caution." Naval War College Review, Spring 1995, 7-21.